1 Forward chaining

In this section, we will be proving a statement using forward chaining.

There is currently a war going on and the United States is desperate to round up all the criminals. We want to determine whether Colonel West is a criminal. Let’s start with what we know.

We know that it is a crime for an American to sell weapons to hostile nations. The country Nono is an enemy of America. Furthermore, we know that Nono has some missiles, all of which were sold to it by Colonel West, who is American.

(a) Represent your knowledge base using first order logic. You can use the following function predicates: American(x), Criminal(x), Hostile(x), Missile(x), Weapon(x), Enemy(x,y), Owns(x,y), Sells(x,y,z).

1. \( \text{American}(x) \land \text{Missile}(x) \land \ldots \Rightarrow \text{Criminal}(x) \)
2. Missile(x) \( \Rightarrow \) ________________
3. Missile(m)
4. Owns(nono, m)
5. Missile(x) \( \land \) ________________ \( \Rightarrow \) Sells(west, x, nono)
6. Enemy(x, america) \( \Rightarrow \) ________________
7. ________________
8. ________________

(b) Fill in the blanks below using your knowledge base to prove that Colonel West is a criminal.
2 Planning Tower of Hanoi

In the Tower of Hanoi problem, you are given \( n \) disks, each of a distinct size, and 3 rods, \( A, B \) and \( C \). The disks start off stacked on top of each other on rod \( A \), stacked from largest being the lowest to smallest being the highest in a “tower”, and the goal is to move that tower to the rod \( C \). You can only move a disk to an empty rod or on top of a larger disks, and disks may only have one other disk on its surface (they must be stacked linearly).

(a) Assume we have 3 disks. Formulate the problem as a graph-planning problem, specifying instances, operators, and start/goal states.

(b) Draw the planning graph for the first 3 moves. You may use pictures instead of propositions.

(c) Generalize the problem formulation for \( n \) disks.
3 Discussion-Based Questions

Let us consider forward-chaining in both a first-order logic and propositional logic setting. Find someone sitting near you to talk through the following questions with, and take some time to look through the following pseudocode snippets from the textbook.

(a) First things first, what are some similarities and distinctions between propositional logic and first order logic?
(b) Compare and contrast these two algorithms. At a high level, what similarities can you identify, and where are there differences?

(c) Now, consider the forward-chaining algorithm presented in Figure 2. It is designed to be conceptually straightforward, but is rather inefficient. What inefficiencies can you identify in this code?